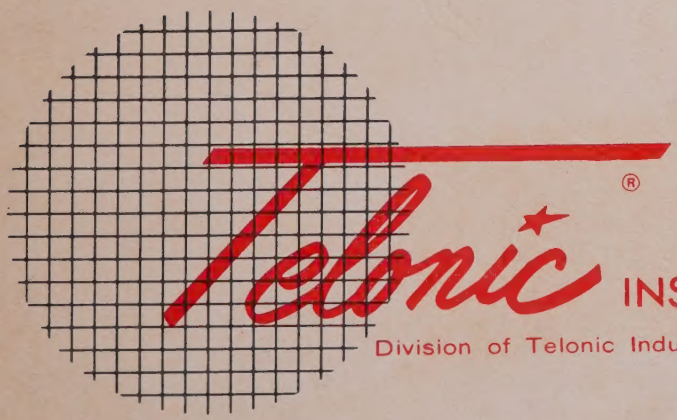
ME-4760/R2

OPERATION
AND
SERVICE MANUAL

MODEL SH-1/SH-1M
T.O.S. No. 111C
SERIAL NO. A19501
PLUG IN OSCILLATOR



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TELONIC INSTRUMENTS AND ACCESSORIES

Products manufactured by TELONIC INSTRUMENTS; Division of Telonic Industries, Inc. are guaranteed against defective materials and workmanship for a period of one year (vacuum tubes excepted) from date of purchase. This warranty does not apply to instruments that have been altered, improperly handled or damaged in any way beyond our control.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold.

RETURNING EQUIPMENT TO FACTORY

Factory service is available for repair and readjustment of this instrument. However, a description of the trouble, plus the MODEL AND SERIAL NUMBERS of the unit must be forwarded FIRST, whereupon instructions for correcting the trouble OR authorization for returning the equipment will be given. This applies to all units, whether under warranty or not. Contact TELONIC INSTRUMENTS at Post Office Box 87, Beech Grove, Indiana 46107 or your local TELONIC representative.

MODEL SH-1/SH-1M
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CONVERSION INFORMATION

Commencing with equipment shipped after about July 22, 1963, certain modifications have been incorporated in the Telonic SM-2000 plug-in series, and in the Telonic SM-2000 control chassis. These modifications may render the units incompatible with those previously shipped unless the earlier instruments are modified also. The equipment in which these modifications have been made can be identified by the letter "A" prefixed to the serial number.

Units not so identified must be modified if they are to be compatible with instruments now being shipped. The modifications to be made are listed below, divided into two groups - those to be made to earlier SM-2000's and those to be made to earlier plug-ins.

SM-2000 CHANGES

1. On J601, remove all wires presently connected to pin 8 and reconnect them at pin 7; remove the jumper between pins 7 and 8.

2. Using shielded wire, type RG-174/U or equal, connect pin 8 of J601 to the printed circuit board land which leads to pin 1, V303. Ground the shield by connecting it to a convenient ground land nearby.

3. Prefix the letter "A" to the serial number of the instrument.

PLUG-IN CHANGES

1. On P601 remove all wires presently connected to Pin 8 and reconnect them at pin 7; remove the jumper between pins 7 and 8 if one is connected.

2. Prefix the letter "A" to the serial number of the instrument, if none is prefixed.

Changing the serial number of the instrument is as important in the modification as are the electrical requirements, as the ability to identify a unit as having been or not having been modified is involved.

SECTION I .. SPECIFICATIONS

The SH-1 is a plug-in sweep oscillator for use with designated Telonic Control Chassis. The sweep ratio and sweep rate functions of the control chassis are not utilized with this unit.

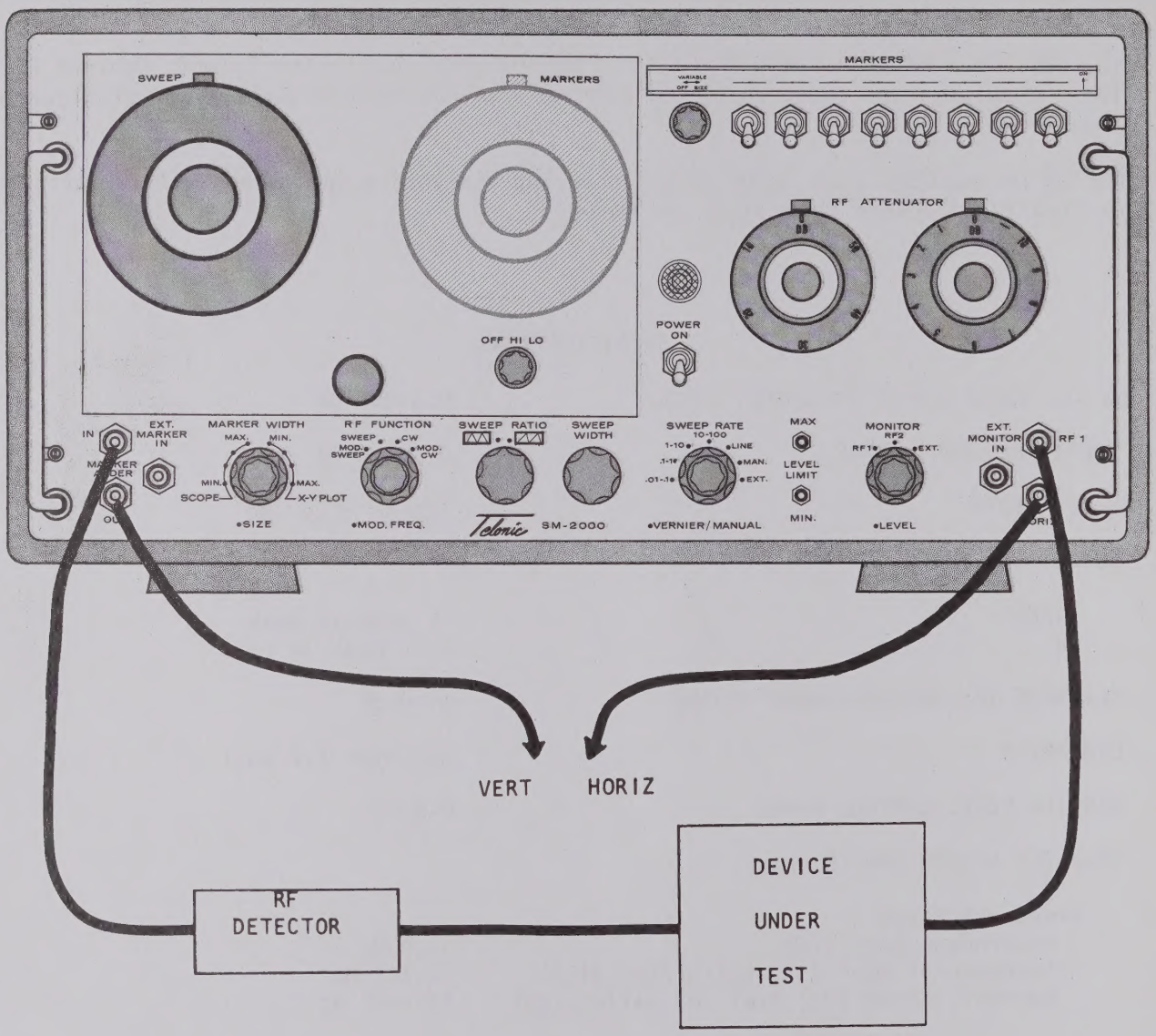
The SH-1M includes a variable marker covering the entire sweep range. This difference is clearly indicated throughout the manual.

SPECIFICATIONS

CW AND SWEEP CENTER FREQUENCY RANGE	0.5-460 Mc
SWEPT FREQUENCY RANGE	0.5-460 Mc
SWEEP WIDTH	200 Kc - 200 Mc
OUTPUT VOLTAGE	
SWEEP	1v peak to peak
CW	0.5v peak to peak
FLATNESS (At maximum sweep width)	±1.0 db
LINEARITY	Not over 1.2 to 1
VERNIER LEVEL CONTROL RANGE	0-6 db
VARIABLE MARKER (SH-1M only)	
Frequency Range	
Heterodyne Band (LO)	0-50 Mc
Fundamental Band (HI, calibrated dial)	50-125 Mc
Harmonic Bands (HI, dial not calibrated)	125-460 Mc
Accuracy	
Heterodyne Band	± 300 Kc
Fundamental and Harmonic Bands	± 0.25%

SECTION II .. OPERATING INSTRUCTIONS

TYPICAL SET UP



The front panel contains three controls (one only if variable marker is not installed).

SWEEP — The Sweep Dial, which sets the center frequency of the tunable oscillator by means of a variable capacitor.

MARKER — The Variable Marker Dial, calibrated in two ranges. This control also adjusts frequency with a variable capacitor.

OFF HI LO — This controls the range over which the variable marker operates. In the LO position, a 60 mc crystal oscillator is turned on, providing a heterodyne variable marker over the 0.5-50 mc range of the output.

GENERAL

1. Make sure the control chassis power is OFF before inserting the plug-in oscillator into the control chassis. If the power is ON, transient voltages may damage diodes in the units. Insert plug-in oscillator and secure it in the chassis by tightening the fastening rod with the knob in the lower center of the front panel.

2. Make connections to the scope (or recorder), the device under test, and RF Detector as shown. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator (50Ω). If the input impedance of the device under test is other than 50Ω, a matching network should be used to insure a constant input signal.

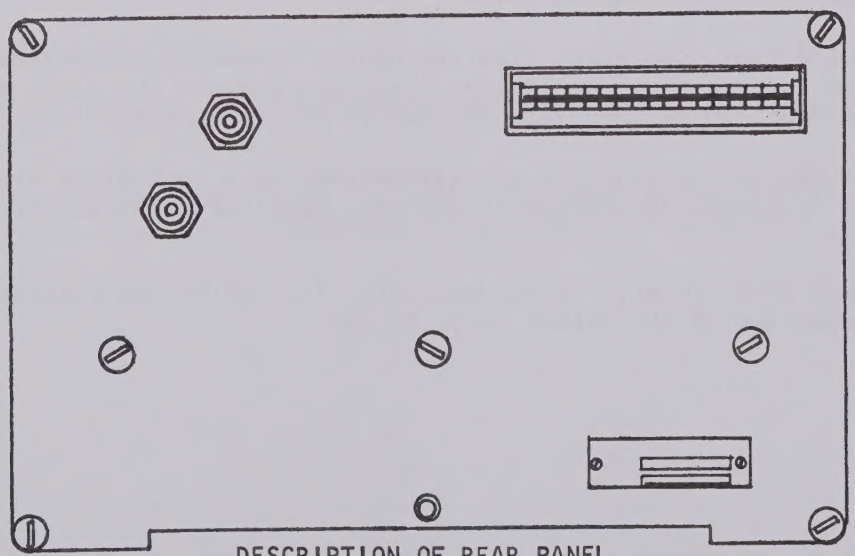
3. Refer to the manual for the control chassis for additional instructions. NOTE: To insure a constant amplitude output signal, the LEVEL MAX and MIN Controls on the control chassis should be set as prescribed in the control chassis manual. This adjustment varies with the individual plug-in oscillator.

4. To insure proper operation of both units, refer to Section IV (CALIBRATION PROCEDURE) of both manuals.

5. Proceed in accordance with recommendations of the manufacturer of the device under test concerning alignment, adjustment, and tests.

* See Telonic literature for suitable detector for this use.

DRAWING OF REAR PANEL



DESCRIPTION OF REAR PANEL

The three electrical connectors on the rear panel are:

Two BNC plugs, which mate with BNC jacks on the control chassis. These are the RF output connector and variable marker output.

A 32-contact plug which makes the other electrical contacts necessary through a mating jack on the control chassis.

SECTION III .. GENERAL DESCRIPTION

GENERAL

The SH-1 plug-in oscillator has a heterodyne RF output derived from a sweep oscillator which has a center frequency of about 1000 Mc and a second oscillator tunable from the same frequency to 460 Mc lower.

The variable marker, also a heterodyne signal, is producted by a 60 Mc crystal-controled oscillator and an oscillator tunable over the 50-125 Mc range.

SWEEP OSCILLATOR

The sweep oscillator employs a 6AF4A in a tuned-line type oscillator circuit.

A linear sweep (frequency change versus horizontal display) is provided by a variable capacitor which is sine wave driven by a motor secured at the base of the sweep oscillator assembly. Capacity changes as the effective plate area is varied by vibrating the movable plates in and out between the fixed plates. The rate of vibration is fixed at 60 c.p.s. (line frequency), and the amplitude is determined by the SWEEP WIDTH Controls on the SH-1 and the control chassis. The vertical position of the vibrating plates is carefully adjusted at the factory for optimum linearity and sweep width. Since a sine wave voltage drives both the motor and the horizontal deflection plates of the oscilloscope, the frequency change versus horizontal deflection trace appearing on the scope represents the true linearity of the sweep oscillator.

The B+ supply to the sweep oscillator is leveled automatically as described in the control chassis manual.

TUNABLE OSCILLATOR AND HETERODYNE OUTPUT

The tunable oscillator, operating from the center frequency of the sweep oscillator to 460 Mc below, also employs tuned-line circuitry between the plate and grid of a 6AF4A. A dual tuning capacitor determines the frequency.

The outputs of the two oscillators are heterodyned in a four-diode mixer circuit. The difference frequency is coupled to the rear panel RF connector through a low-pass filter.

The tunable oscillator B+ also is automatically leveled by the control chassis to adjust for tendencies of the output level to vary.

VARIABLE MARKER

General

The variable marker is derived by three different methods over different portions of the swept output frequency range of the SH-1M:

In the 0.5-50 Mc range, the variable marker signal is the difference frequency between a 60 Mc crystal oscillator and a variable oscillator tunable from 50-125 Mc.

From 50-125 Mc, the crystal oscillator is turned off and the marker is the fundamental output of the tunable oscillator.

Over the rest of the band (125-460 Mc), the second, third, or fourth harmonic of the tunable oscillator output is used.

The dial is calibrated over the heterodyne and fundamental bands only.

Crystal Oscillator

The 60 Mc crystal oscillator is a modified Colpitts circuit with a series resonant crystal as the feedback element.

The signals from this oscillator and the tunable oscillator are loop-coupled to a common output circuit.

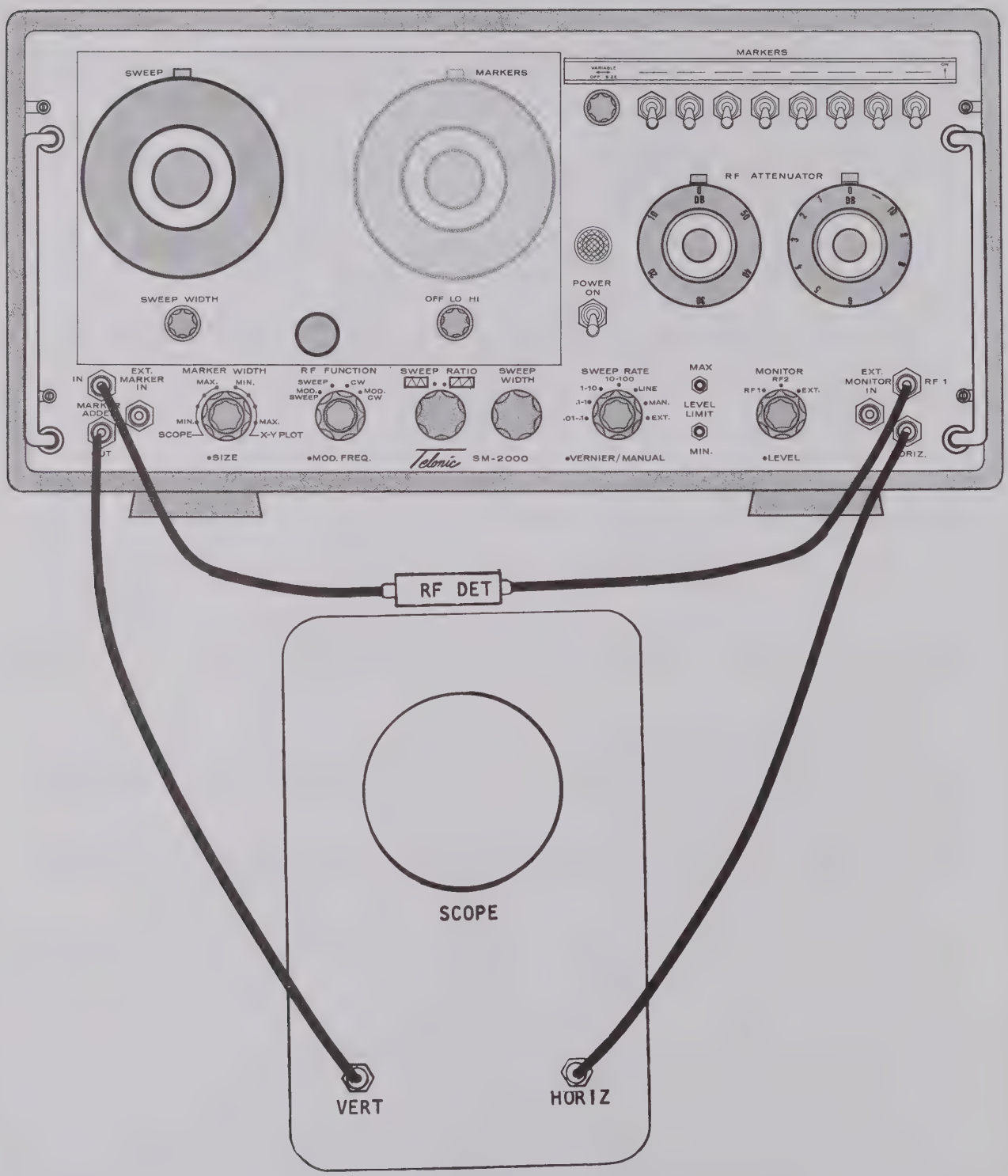
A test point is provided for an easy check on circuit operation. A switch in the B+ line to the crystal oscillator plate allows this circuit to be disabled manually when ranges above 50 Mc are required.

Tunable Marker Oscillator

The marker oscillator is a Hartley-type grounded plate oscillator tunable from 50-125 Mc.

Both capacitance and inductance are adjustable over a sufficiently wide range to maintain marker dial calibration when components are changed.

SECTION IV .. CALIBRATION PROCEDURE



TYPICAL SET UP

SECTION IV .. CALIBRATION PROCEDURE

GENERAL

The following procedure should be applied after changing any component in the SH-1, or at any time calibration is noted to be incorrect.

Complete calibration of the SH-1 involves adjustment of two classes of controls:

Those located in the SH-1 which affect the operation of the control chassis.

Those located in the control chassis which affect the operation of the SH-1.

NOTE: Although preliminary adjustments may be made with the covers removed from the oscillator section and marker box, final adjustment requires that the covers be in place. See Chassis Layout, Section VII, for location of all adjustments.

TEST EQUIPMENT

Calibrated detector (such as the Telonic Model XD-3A)
50 Mc harmonic marker (such as the Telonic Model CDH-50)
Oscilloscope

PROCEDURE

1. Make connections as shown.

2. Use double-shielded (RG) 50Ω cable for all RF connections to insure good connections and minimum radiation, and to avoid pickup of spurious signals. The detector must match the 50Ω cable, or a matching network must be used.

3. With power OFF, plug in the SH-1 and secure in place.

4. Turn power ON, allow a 60-minute warm up period, and make adjustments as outlined.

SWEEP WIDTH (Adjustment)

This adjustment is set to provide 200 Mc sweep width. Since the sweep width is constant, a 200 Mc setting at 300 Mc insures sufficient sweep width at all frequencies.

Preset the following controls:

Control Chassis
- SWEEP WIDTH fully clockwise
- RF FUNCTION Switch to SWEEP
- MONITOR Switch to RF 1
- 50 Mc harmonic marker ON
- All other markers OFF

SH-1
- SWEEP Dial to 300 Mc

CALIBRATION PROCEDURE

Adjust the SH-1 SWEEP WIDTH Control for four full marker intervals on the scope. This can be accomplished accurately by alternately adjusting the SWEEP Dial and SWEEP WIDTH Control to place a marker at each end of the trace with three markers between. Due to some non-linearity, the SWEEP Dial will not read exactly 300 Mc at the conclusion of this adjustment.

BLANKING PHASE (adjustment)

After the SWEEP WIDTH adjustment, this control is set for a rectangular pattern. Misadjustment will result in a pattern similar to the following:

HORIZONTAL PHASE (Adjustment)

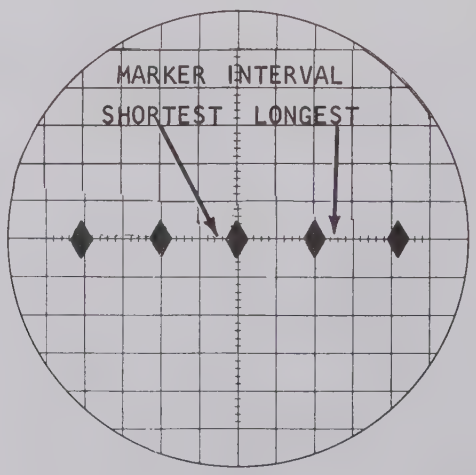
After completing the blanking phase adjustment, set this control for the best linearity possible, still maintaining a reasonably rectangular pattern. See LINEARITY CHECK below. If necessary, readjust the BLANKING PHASE Control following this adjustment.

LINEARITY CHECK

Linearity measurements are made at maximum sweep width.

Leave controls set as at the conclusion of the HORIZONTAL PHASE adjustment.

Locate the shortest marker interval in the display. Adjust the horizontal gain control on the scope so that this interval occupies exactly two scope divisions. Locate the longest marker interval in the display. Adjust the horizontal position on the scope so that the interval begins on a graticule line. See Figure below. Measure the marker interval. Its length (in scope divisions) is twice the linearity ratio: A length of 2.30 scope divisions for the longest marker interval represents a linearity of 1.15 to 1.



SWEEP B+ (Adjustment)

This control limits the maximum oscillator B+ to a safe operating level. It is set for rated RF output.

1. Preset the following controls:

   Control Chassis
   - RF FUNCTION Switch to SWEEP
   - SWEEP WIDTH fully counter-clockwise
   - MONITOR Switch in EXT position
   - LEVEL fully clockwise
   - MAX LEVEL LIMIT for maximum output
   - RF ATTENUATORS to 0 db position

   SH-1
   - SWEEP B+ fully counter-clockwise
   - SWEEP Dial for frequency at which output is lowest

2. Adjust the SWEEP B+ for just over 1 volt peak-to-peak output. Considering the efficiency of the XD-3A at this level and frequency, 1v peak-to-peak corresponds to an XD-3A DC output of about 0.35v.

   NOTE: A fixed B+ limit is used in the CW, MOD CW modes.

MAX AND MIN LEVEL LIMIT (Control Chassis)

The procedure outlined in the Control Chassis Manual for setting these controls is repeated here, with additional information peculiar to operation with the SH-1.

1. With the detector and scope still connected, and controls set as at the conclusion of the SWEEP B+ Adjustment, adjust the MAX LEVEL LIMIT for rated output.

2. Insert fixed attenuation in an amount equal to the desired range of the LEVEL Control, not to exceed 10 db.

3. Note the level of the scope pattern.

4. Remove attenuation, rotate LEVEL Control fully counter-clockwise. Set MIN LEVEL LIMIT for same scope deflection as seen in Step 3.

FLATNESS CHECK

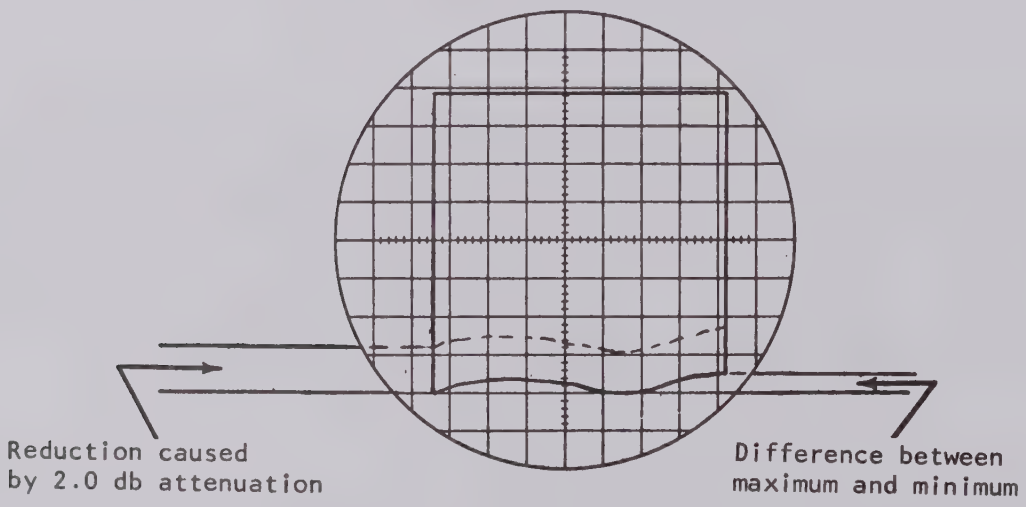
Flatness is measured over maximum sweep width. At any center frequency setting, the minimum output at full sweep width must be no more than 2.0 db lower than the maximum.

1. With controls set as above, rotate the LEVEL and SWEEP WIDTH Controls fully clockwise, and set the MONITOR Selector in the RF 1 position.

2. Rotate the SWEEP Dial to locate the point at which maximum tilt, or other unflatness feature, occurs.

3. Note the difference between maximum and minimum output levels.

4. Insert 2 db of attenuation and compare the reduction in output with the noted difference between maximum and minimum. The difference between maximum and minimum output must be no more than the signal reduction caused by 2 db of attenuation.



VARIABLE MARKER ADJUSTMENT

General

Variable marker alignment involves adjustment of the 60 Mc crystal oscillator and of the tunable oscillator.

Crystal Oscillator

A test point (C809) is provided for easy adjustment of this circuit. See Chassis Layout, Section VII, for location of this point.

With the BAND HI-LO Switch in the LO position, L802 is adjusted for near maximum negative voltage at this point. The setting should be just off maximum on the low inductance (high frequency) side. Adjustment is critical on the high inductance side, and oscillation is likely to cease if attempt is made to adjust for maximum voltage.

Tunable Oscillator

After completion of the crystal oscillator adjustment, turn the BAND HI-LO Switch to the HI position and turn ON the 25 Mc marker and set the SWEEP dial to 50 Mc.

Set the MARKER Dial at 50 Mc on the 50-125 Mc range. Adjust L801 to superimpose the variable marker over the 50 Mc marker.

Set the SWEEP and MARKER Dial at 125 Mc. Adjust C801 to superimpose the variable marker over the 125 Mc marker.

Because of interaction between L801 and C801, it may be necessary to "rock" or readjust these controls several times for best accuracy. It may be desirable to adjust instead for best dial accuracy at a particular frequency or band of frequencies, in which case other fixed markers may be required.

SECTION V .. MAINTENANCE

GENERAL PROCEDURE

Since this is a plug-in unit, many of the possible malfunctions of the oscillator are the result of part failure in the control chassis. The connections at P601 of the plug-in and at J601 of the control chassis afford a convenient means of tracing the source of troubles to the oscillator or chassis.

In locating troubles which have been traced to the oscillator, application of the common rules of electronic maintenance, including a visual check for damage, open filaments, glowing anodes, shorted tuning capacitors, and charred resistors, is an obvious measure. All connectors, particularly P601 and J601, should be checked for cleanliness.

EXTENSION CABLE

For maintenance work requiring access to parts located on the under side of the plug-in, or in other areas not easily reached, an extension cable may be obtained from Telonic Industries, Inc. This cable, having the 32-contact plug on one end and the 32-contact jack on the other, allows the SH-1 to be removed from the control chassis and operated on the bench.

ACCESS TO RF COMPARTMENT

To take off the top cover of the oscillator compartment, remove the necessary screws.

> CAUTION: The screws securing the drive motor to the bottom of the compartment should not be disturbed. The position of this drive motor is critical, and these mounting screws are factory adjusted for optimum oscillator performance. DO NOT REMOVE ANY SCREWS WHICH ARE RED-LACQUERED. These screws are used to fasten RF shields in place and have nothing to do with holding the covers.

The following chart will be of service in deciding whether a trouble lies in the oscillator or control chassis.

It is assumed that the above procedures have been applied and that the jumpers on P601 are intact. Where "inconclusive" is shown, the next step should be followed.

SYMPTOM	Check (Pin Numbers refer to P601)	IF RESULT IS	OSCILLATOR	CONTROL CHASSIS
Weak or no output or unleveled output.	DC voltage at Pin 31 with RF LEVEL fully clockwise.	High 100-175v	X	
		Low or zero 0-100v		X
No Sweep Width.	Resistance between Pins 27 and 9, 26 and 27, 26 and ground	Open between 27 and 9	X	
		26 and 27		X
		26 and ground	X	
		Continuity on all checks		X
No variable marker (plug-in marker present)	1. For birdy at Pin 17	Birdy present		X
		No birdy	Inconclusive. See Check #2.	
	2. DC voltage at Pin 1	100v	X	
		Low or no voltage		X

If the chart shows that the trouble probably is in the control chassis, refer to the MAINTENANCE Section of the manual for that unit. A common trouble is unleveled RF 1 output due to failure of the monitor diode in the control chassis. This part can be replaced as necessary by following the procedure outlined in the control chassis manual.

If the trouble appears to be in the plug-in the following chart may be of assistance in localizing the failure.

SYMPTOM	CHECK
Output absent, weak or unleveled	V701 and associated components V702 and associated components
No sweep width	Resistance, P601-26 to ground R605
No variable marker	With BAND HI-LO Switch in LO position, set SWEEP Dial to 60 Mc and check for 60 MC birdy. If present, check tunable oscillator circuit. If not, check V801 other components.
No "Lo" band marker	V801B and associated components

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SECTION VI

PARTS LIST FOR SH-1

CIRCUIT REFERENCE	DESCRIPTION	TELONIC PART NUMBER
C601	CFM, 0.1μf, ±20%, 200VDCW	C-200
C602	CFE (SC)	Not assigned
C603	CFD 0.005μf	C-49
C701	Part of L701, L702, Z702	Not assigned
C702	CFC, 0.01μf, +80-20%, 500VDCW	C-20
C703, C704	CVA	Not assigned
C705	CFCF, 1000pf, 100%-0%, 500VDCW	C-110
C706	Same as C705	
C707-C709	Not assigned	
C710-C713	Same as C705	
CR701	DSD, 1N25A	D-8
CR702-CR704	Same as CR701	
L701-L704	IF	Not assigned
L705	IF, 2.2μh	L-100
L706-L708	IF (SC)	Not assigned
L709	IF, 1.0μh	L-102
L710	IF (SC)	Not assigned
L711, L712	Same as L705	
P601	Plug, 32-contact	S-39
P701	PC, UG-88C/U	J-13
P702	PC, 4961-1	J-27
R601	RVC, 50KΩ, ±30%, 0.2W	R-725
R602	Same as R601	
R603	RFC, 56KΩ, ±10%, 1/2W	R-71
R604	RFC, 68KΩ, ±10%, 1/2W	R-51
R605	RVW, 25Ω, ±10%, 5W	R-782
R606	RVC, 200KΩ, ±30%, 0.2W	R-724
R607	RFC, 15KΩ, ±10%, 1/2W	R-66
R608	RFC, 220KΩ, ±10%, 1/2W	R-44
R609	RFW, 2Ω, ±5%, 5W	R-422
R701	RFC, 8.2KΩ, ±10%, 1/2W	R-43
R702	RFC, 47Ω, ±10%, 1W	R-200
R703, R704	Same as R702	
R705	RFC, 5.6KΩ, ±10%, 1/2W	R-22
V701	TE, 6AF4A	VT-4
V702	Same as V701	
Z701	Low pass filter	06030
Z702	Drive motor assembly	09096

* TE, 6DZ4, Telonic Part Number VT-51 are used as an alternate in this unit.

VARIABLE MARKER (SH-1M ONLY)

CIRCUIT REFERENCE	DESCRIPTION	TELONIC PART NUMBER
C801	CVG, 0.7-12 pf	C-414
C802	CVA, 100 pf max.	C-441
C803	CFC, 33 pf, ±10%, 1000VDCW	C-10
C804	CFC, 7 pf, ±5%, 1000VDCW	C-5
C805	Same as C803	
C806	CFC, 1000 pf, GMV, 1000VDCW	C-19
C807, C808	Same as C806	
C809	CFCF, 1000 pf, 100%-0%, 500VDCW	C-110
C810 - C812	Same as C809	
J801	RJ, UG-625/U	J-7
P801	PC, UG-88C/U	J-13
P802	PC, 4961-1	
L801	IV	25023
L802	IV	25024
L803	IF, 2.2µh	L-100
L804	IF, 2.2µh	L-101
R801	RFC, 10KΩ, ±10%, 1/2W	R-23
R802	RFC, 4.7KΩ, ±10%, 1/2W	R-21
R803	RFC, 10KΩ, ±10%, 1/2W	R-23
R804	RFC, 56KΩ, ±10%, 1/2W	R-71
R805	Same as R801	
R806	RFC, 22Ω, ±10%, 1/2W	R-11
R807	RFC, 330Ω, ±10%, 1/2W	R-17
R808	Same as R807	
S801	Switch, wafer, 2 pole, 3 position	SW-46
V801	TE, 6DJ8	VT-62
Y801	Crystal, series overtone	Not assigned

ABBREVIATION CODE

CFC	Capacitor, fixed, ceramic
CFCF	Capacitor, fixed, ceramic feed-thru
CFD	Capacitor, fixed, Discap
CFE	Capacitor, fixed, electrolytic
CFM	Capacitor, fixed, Mylar
CVA	Capacitor, variable, air-dielectric
CVG	Capacitor, variable, glass
DSD	Diode, semiconductor device
IF	Inductor, fixed
IV	Inductor, variable
PC	Plug, cable
RFC	Resistor, fixed, composition
RFW	Resistor, fixed, wirewound
RVC	Resistor, variable, composition
RVW	Resistor, variable, wirewound
RJ	Receptacle, Jack
SC	Subject to change
TE	Tube, electron

SECTION VII

SCHEMATIC DIAGRAMS

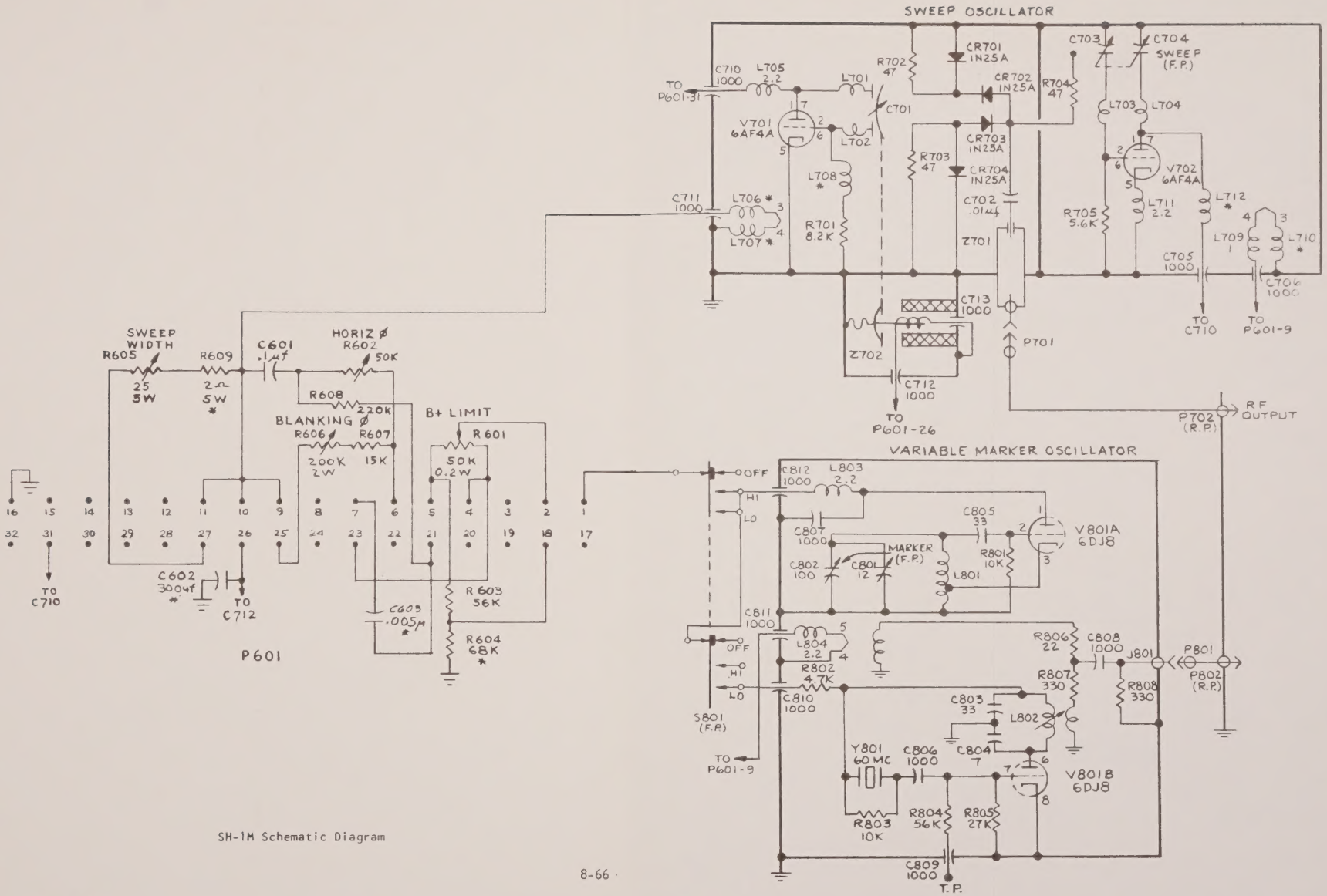
RESISTORS - All resistors are 1/2 watt, ± 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are ± 1%.

CAPACITORS - All capacitors are shown in picofarads (pf) unless otherwise specified.

INDUCTORS - All inductors are shown in microhenries (μh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
R.P. Rear Panel
T.P. Test Point



SH-1M Schematic Diagram

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